Chapter 18
Station and Equipment Grounding

18-1. General

Following are the recommended practices for system and equipment grounding in pumping stations. However, special applications may require variations to the recommended practices. A thorough discussion of grounding principles can be found in ANSI/IEEE 142, Recommended Practices for Grounding of Industrial and Commercial Power Systems. Installations should also comply with the applicable provisions of Article 250 - Grounding of the National Electric Code (NFPA-70). Typical grounding plans are shown on Plates 21 and 22.

18-2. Station and Equipment Grounding

a. General. An effective grounding system is an essential part of a pump station electrical system. In general, 19-millimeter (3/4-inch) by 6-meter (20-foot) ground rods should be driven at the corners of the structure and exothermically joined to a ground bus run completely around the periphery of the pumping station. The ground bus should be installed a minimum of 0.5 meter (18 inches) outside the building wall and a minimum of 0.8 meter (30 inches) below the finished grade. Additional lengths or numbers of ground rods should be added as required to achieve a maximum resistance to ground of 25 ohms. In rocky ground where driven rods are impractical, it is sometimes more economical and desirable to use a grid system with cable spacings of approximately 3 meters (10 feet) being common. The cables should be placed 150 millimeters (6 inches) to 300 millimeters (1 foot) deep and encased in concrete.

b. Grounding conductors. At least four grounding conductors should be run from the ground bus or grid and exothermically welded to a ground loop embedded in the operating floor. All connections to either the ground loop or ground bus should be by exothermic welds.

c. Ground bus. The ground bus should be exothermically connected to the sump floor rebars, any steel columns of the structure, and metallic underground water piping where present.

d. Sizing of grounding bus and loop conductors. Sizing of grounding bus and loop conductors should be made in accordance with the applicable requirements of the National Electrical Code (NFPA-70). For mechanical strength, however, the grounding conductors should not be smaller than No. 2/0-AWG conductor. However, it may be desirable to exceed these values where exceptional precaution is required or where extremely high ground-fault currents are expected.

e. Frames and enclosures. The frames of stationary or permanently located motors, and the frames and enclosures of static equipment such as transformers should be grounded by direct connection to the operating floor ground loop through an equipment grounding conductor equal in size to the largest conductor in the line connected to the equipment, but in general not less than No. 6 AWG. The equipment grounding conductors shall be connected to the equipment through the use of a clamp-type connector.

f. Switchgear. To provide a convenient method of grounding switchgear, a ground bus should be provided as part of the equipment. The switchgear ground bus must not be smaller in current-carrying capacity than 25 percent of the highest continuous-current rating of any piece of primary apparatus to which it is connected. The switchgear ground bus should, in turn, be connected to the operating floor ground loop by conductors having a current-carrying capacity equal to that of the switchgear ground bus.

g. Other noncurrent carrying metal. All other noncurrent carrying metal such as ladders, fences, fuel-storage tanks, etc., shall be connected to either the ground bus or operating floor ground loop. All neutral conductors of grounded power supplies shall be solidly grounded to the station ground system.

h. Utility power. The utility furnishing power to the station should be contacted to determine if any interconnections are required between the pumping station ground grid and the substation ground grid.

18-3. System Grounding

a. General. The basic reasons for system grounding are the following:

(1) To limit the difference of electric potential between all uninsulated conducting objects in a local area.

(2) To provide for isolation of faulted equipment and circuits when a fault occurs.

(3) To limit overvoltage appearing on the system under various conditions.

b. Low-voltage systems. It is recommended that pumping stations with electrical systems of 1,000 volts and below be solidly grounded. Solid grounding is the least expensive way to detect and selectively isolate ground fault through the usage of fast-acting ground-fault relaying. However, use of a solidly grounded low-voltage distribution system increases the probability of damage from arcing ground faults. The driving voltage of these systems tends to sustain arcs rather than clear them through the standard phase overcurrent protective devices. High impedances associated with the arc may limit fault current to levels too low for detection by conventional over-current protective devices. For this reason, sensitive ground-fault relaying should be provided on the feeders and the main of all solidly grounded systems. Ungrounded operation of low-voltage systems is not recommended because of the potential over-voltage problems.

c. Medium-voltage systems. Modern power systems in this range of voltages are usually low-resistance grounded to limit the damage due to ground faults in the windings of rotating machines and yet permit sufficient fault current for the detection and selective isolation of individually faulted circuits. The lowest ground-fault current (highest resistance) consistent with adequate ground relay sensitivity should be used. High-resistance grounding is not recommended for medium-voltage systems.